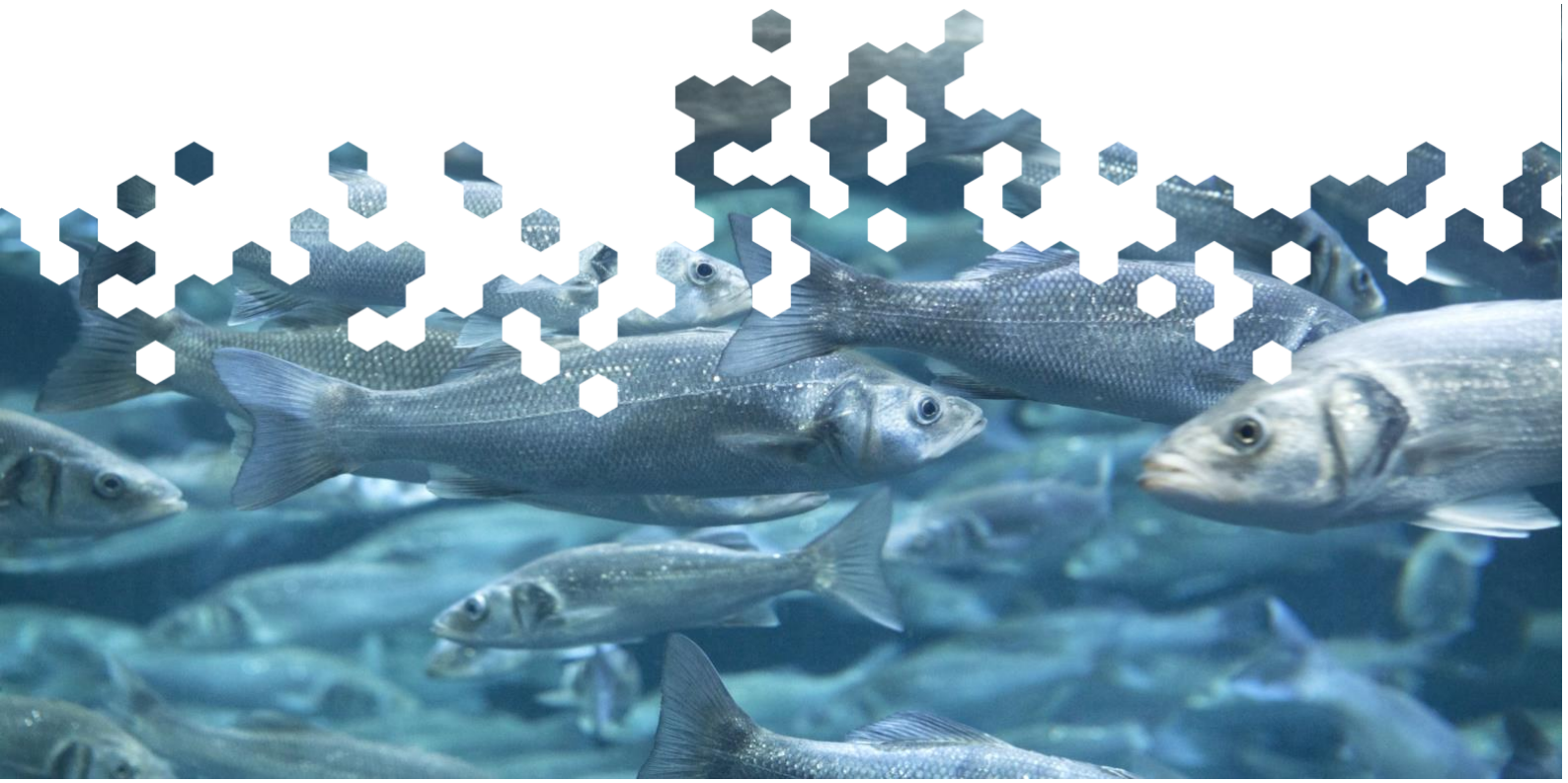
Highest Priority Research Areas for Finfish Health

Policy Brief April 2025

Policy brief



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Introduction

Aquaculture is crucial for food security, health, economic growth, and aquatic ecosystem protection (Sustainable Development Goals (SDGs) 2, 3, 8, and 14)[1]. However, disease costs the aquaculture industry over 6 billion USD annually impacting production, livelihoods, and ecosystems[2]. The growing risk of occurrence and spread of aquaculture-related aquatic animal disease has been associated with the intensification of production systems, domestication of new species, climate change and expansion of global trade. Research is vital to drive innovation and address these increasing challenges, ensuring safe and sustainable aquaculture production. Under the framework of the WOAH Aquatic Animal Health Strategy Activity 4.5[3], the World Organisation for Animal Health (WOAH) and the STAR IDAZ International Research Consortium on Animal Health (STAR-IDAZ IRC)joined forces to identify the highest priority research areas for advancing aquatic health research. It is through collaborative research efforts that we can foster innovation and improve the safe and sustainable development of the aquaculture sector, addressing both current and future challenges.

Methods

The aquaculture scientific community came together in 2025 to identify the highest-priority areas for research that will provide lasting benefits for the global management of aquatic animal diseases, particularly those that will impact international standards. An online global consultation was launched in January 2025 inviting more than 440 experts from 187 countries (response rate 43%, n=184) to share, via a survey, ideas on research priorities for the sectors finfish, molluscs, crustaceans and amphibians[4]. A workshop was subsequently organized, with more than 40 international experts convening at WOAH Headquarters to further discuss and refine the survey results on finfish, the most productive aquaculture sector in volume and value at global level. Experts looked collaboratively at the challenges of the finfish sector and integrated their knowledge to identify transformative solutions needed to overcome the obstacles ahead[5].

[1] Troell, M., Jonell, M., & Henriksson, P. J. G. (2023). Perspectives on aquaculture's contribution to the Sustainable Development Goals. *Journal of the World Aquaculture Society, 54*(1), 10–28. https://doi.org/10.1111/jwas.12946
[2] World Bank. (2014). *Reducing disease risk in aquaculture*. WORLD BANK REPORT NUMBER 88257-GLB. The International Bank for Reconstruction and Development/The World Bank. Retrieved from https://documents.worldbank.org/curated/en/110681468054563438/pdf/882570REPLACEM00NAME0Reantaso0Melba.pdf
[3] World Organisation for Animal Health. (2021). *Aquatic Animal Health Strategy 2021–2025*. https://www.woah.org/en/what-we-do/animal-health-and-welfare/aquatic-animals/#ui-id-1
[4] Aquaculture Health Research Survey. https://www.star-idaz.net/priority-topic/aquatic-diseases/
[5] Advancing Aquculture Health Research. https://www.star-idaz.net/priority-topic/aquatic-diseases/

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Highest research priorities for finfish health

The priority areas listed below are those identified for advancing aquaculture research on finfish for a healthier, sustainable, and innovative aquaculture sector.

Epidemiology and control strategy: highest research priority areas

Most urgent:

- Validation of diagnostic tools both for traditional testing of notifiable diseases, new test systems including rapid test for field diagnostics, eNA and biomarkers, and research for optimization of sample pooling (see diagnostic section below)
- Increased understanding of host-pathogen-environment interaction
- Research for sustaining control strategies of transboundary diseases and early warning (see table of most impactful diseases below)
- Optimization of biosecurity knowledge and implementation for control strategies, water management, fallowing - particularly for low value species, small scale production, and young fish not yet immunocompetent
- Development of disease spread models, improving identification of risk factors, understanding pathogen transmission/dynamics, enhancing risk assessment for trade and considerations relating to antimicrobial use (AMU) and antimicrobial resistance (AMR) and application of zoning for disease control

Other priority research areas:

- Research on how to optimize integrative control strategies including environmental pathobiome and chemical contamination
- Research to improve policy on climate change, use of vaccines, border control, and socioeconomic effects of diseases/disease prevention
- New product development – use of artificial intelligence (AI) - for prevention and control of aquaculture diseases, with strategies adapted to local production systems (see vaccine and therapeutics sections below)
- Increased testing and understanding of susceptible species for pathogens
- Research for improving control strategies to reduce non-notifiable and complex disease impact in different production systems - holistic approach to disease prevention and management (see impactful diseases table below)
- Improvement of genetics and breeding programmes for disease resistance
- Optimization of data sharing, complying to the FAIR principles (findable, accessible, interoperable, and reusable), data collection methods (e.g. remote sensing AI-based data management to improve surveillance and control strategies
- Socio-economic - and cost-benefit studies to increase private-public partnership (PPP) engagement in disease management
- Increased understanding of nutrition, feed safety and agroecological practice effects on aquatic animal health and food safety
- Benchmarking and optimization of decontamination strategies for pathogen inactivation after outbreaks

Diagnostic: highest research priority areas

Most urgent:

- eNA:developing standardized protocols to associate data with infections
- Advance artificial intelligence tools for diagnostics (e.g. AI App for powered recognition of fish diseases by lesions in the field or for improving histopathology diagnosis)
- Optimization of effective sampling protocols (e.g. appropriate samples, non -invasive, non-lethal sampling-particularly for valuable broodstock, transportation techniques from field to lab…)
- Development of point of care tests
- Validation of specific and sensitive screening tests, including for AMR (see table below)

Other priority research areas:

- Biobank: improve access to reference isolates, antibodies, positive diagnostic control samples
- Quality genomics databases applying FAIR principles, particularly for notifiable diseases
- Development of serological tests/monoclonal antibodies
- Development of certified reference materials for aquaculture and standard internal controls to test reagents
- Diagnostic tests for environmental contaminants causing disease
- Study on biomarkers of stress
- Advanced NGS techniques (e.g. metagenomics) to advance diagnostics in unexplained increased mortalities
- Optimization of in vitro models (e.g. cells lines, organoids)
- Advanced diagnostics for syndromic surveillance or multi pathogen high-throughput diagnostics (e.g. eNA, MALDI-TOF, sensors, and AI tools)
- Multiplex diagnostic tests for major host species and pathogens

Vaccine: highest research priority areas

Most urgent:

- Optimization of vaccine delivery systems (e.g. oral, immersion, slow-release adjuvant), particularly to boost mucosal immune response
- Understand better immune response to vaccines to aid vaccine development and to develop the best method of intervention
- Develop and license vaccine platform technologies to speed up vaccine development and use, especially for multivalent vaccines
- Social and cost-benefit studies to increase vaccine uptake by end users (different tables)
- Autogenous vaccine: studies to standardize production, quality testing framework, and usage

Other priority research areas:

- Alternative methods to assess efficacy and effectiveness of vaccines (e.g. mathematical models, such as susceptible-infectious-resistant (SIR) disease transmission models, serological panels for antigenic cross protection)
- Standardization of challenge models to ensure reproducibility, reliability and comparability of experimental results (e.g. i. Define criteria for harmonized protocols for different pathogens, production systems, host and environmental conditions; ii. Determine the most appropriate route, dose and strain of pathogen; iii. Define models that mimic natural infections; iv. Define safety for shedding of pathogens from vaccinated fish)
- Guidelines for registering vaccines/harmonization of regulations
- Studies to reduce vaccine production costs and provide incentives for use of vaccines particularly in low or middle-income countries (LMIC) (e.g. free vaccines for LMIC)
- Investigate regional needs and link with regional PPP initiatives for vaccine research/production
- Optimization of field trials and randomized controlled trials to demonstrate vaccine efficacy

Therapeutic: highest research priority areas

Most urgent:

- Development of alternatives to antimicrobials and innovative methods to identify new compounds for treatment (including use of mathematical models, and AI approaches to target identification)
- Methods and standardization for quantification of water environmental conditions to reduce the pathobiome
- Investigation of antimicrobials not used in humans but already used in other food animals
- More research into alternative disease managements (e.g. heat treatment, feed supplements, phytomedicines)

Other priority research areas:

- Development of more preventative products (e.g. probiotics, immunostimulants)
- Further development of phage therapy
- Studies on knowledge, attitudes and practices (KAP) of farmers to adapt policy and intervention strategies and to guide capacity building activities to reduce antimicrobial use
- Studies to tailor biosecurity plans for different industries

Most impactful pathogens/diseases per species/environment cluster and associated diagnostic and vaccine needs

Disease / pathogen	High impact/specie/environment		Diagnostic	Vaccine
***Aeromonas* spp.**‡	✸	💧 		
	✸	💧 		
	✸	💧 		
	✸	💧 		
				
Amoebic gill disease (AGD)	✸			
***Aphanomyces invadans*; Epizootic ulcerative syndrome (EUS)**	✸	💧 		
	✸	💧 		
	✸	💧 		
	✸	💧 		
Cardiomyopathy syndrome (CMS)		💧 		
				 ¶
Complex gill disease (CGD)	✸			
	✸	💧 		
Edwardisella ictaluri	✸	💧 		
***Flavobacterium* spp.**†	✸	💧 		
	✸	💧 		
	✸	💧 		
	✸	💧 		
***Francisella* spp.**	✸	💧 		
	✸			
Heart and skeletal muscle inflammation (HSMI)				
Infectious haematopoietic necrosis virus (IHNV)	✸	💧		
	✸			¶

Infectious pancreatic necrosis virus (IPNV)				
Infectious salmon anaemia virus (ISAV)				¶
Koi herpesvirus (KHV)				
***Lactococcus* spp*.**				
***Megalocytivirus lates* 1 (SDDV)**				
***Megalocytivirus pagrus* 1 (ISKNV/RSIV/TRBIV)**				
***Moritella* spp.**				¶
Nodular gill disease (NGD)				
Piscirickettsia salmonis (SRS)				
***Renibacterium salmoninarum* (BKD)**				
				¶
Sea lice				
Spring viraemia of carp (SVC)				
***Streptococcus* spp.**				
				¶
***Tenacibaculum* spp.**				¶
Tilapia lake virus (TiLV)				
***Vibrio* spp.**§				
Viral haemorrhagic septicaemia virus (VHSV)				

				 ¶
Viral nervous necrosis virus (VNNV)				

‡Includes: *A. salmonicida, A. hydrophila, A. veronii, A. dhakensis*. †Includes: *F. psychrophilum, F. columnare, F. tilapiae*. *Includes: *L. garvieae, L. petauri, L. formosensis* §Includes: *V. harveyi, V. vulnificus, V. parahaemolyticus,* and *V. alginolyticus.* ¶Vaccines to be administered in early stage of life (freshwater).

Key:			
	Most impactful disease		
	Freshwater		Saltwater
	Salmonids, freshwater		Vaccine (development or improvement)
	Tilapia		Improved isolation and cell culture methods
	Carp		Virulence characterization
	Catfish		Validated diagnostics
	Salmonids, saltwater		Improved molecular methods
	Others, saltwater		Non-lethal sample protocols

Cross-cutting issues to enhance research and innovation

Investing in research is investing in the future capacity of the sector to manage aquatic animal health. For research to be effective and transformative, innovations must transition from the laboratory to real-world application. For this reason, additional transversal issues need to be tackled such as: capacity building, infrastructure development to facilitate equal access to veterinary tools and services, and regulatory harmonization to streamline vaccine approval and product scalability. Clear guidelines for the correct use of veterinary products, and the integration of social science to increase acceptance and uptake by fish farmers and to establish effective communication strategies among different stakeholders, are also essential. Additionally, sustainable management practices and public-private partnerships should be promoted to ensure environmentally responsible production and accelerate innovation in the sector.

Conclusion

To steer meaningful advancements in finfish aquaculture health, it is recommended to allocate targeted funding towards the highest-priority research areas outlined above. Collaborative research efforts together with strategic funding for those research priorities will accelerate the development of tools to enhance disease prevention, detection, and management strategies. These are of foremost importance

to enhance technological innovation in the field, and the development of science-based policies, ensuring a resilient and sustainable future for the aquaculture industry and strengthened global food security.

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[6] Full list in the report: Advancing Aquaculture Health Research. https://www.star-idaz.net/priority-topic/aquatic-diseases/ #reports

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